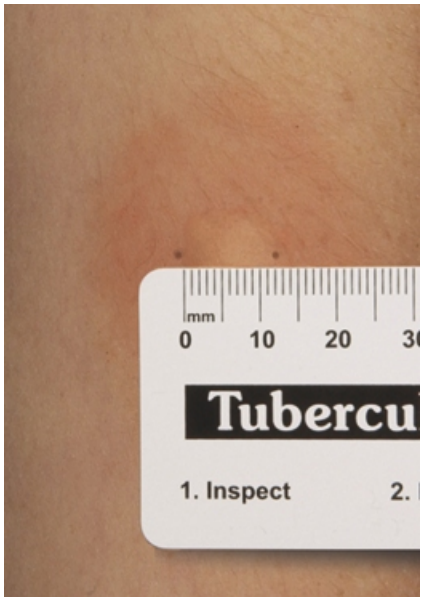

Figure 1. The TST result in this photograph should be recorded as 12 mm. The "0" ruler line is inside the edge of the left dot.

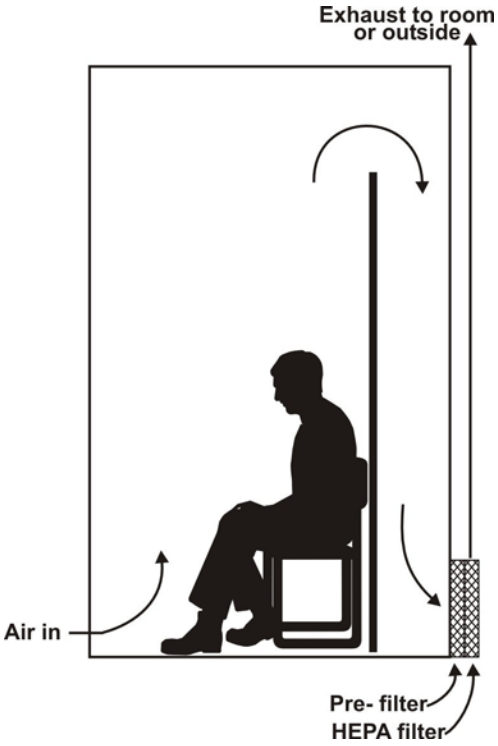

Figure 2. An enclosing booth designed to sweep air past a patient with TB disease and collect the infectious droplet nuclei on a HEPA filter.

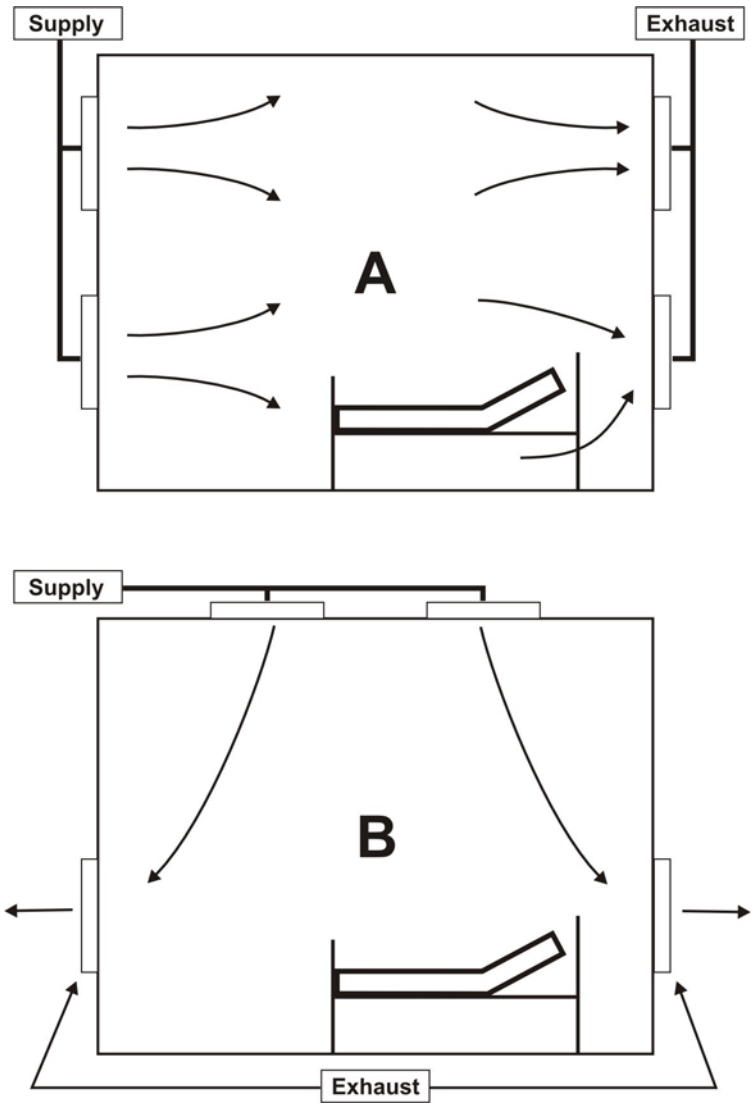

Figure 3A & 3B. Room airflow patterns designed to provide mixing of air and prevent short-circuiting (passage of air directly from the air supply to the exhaust)

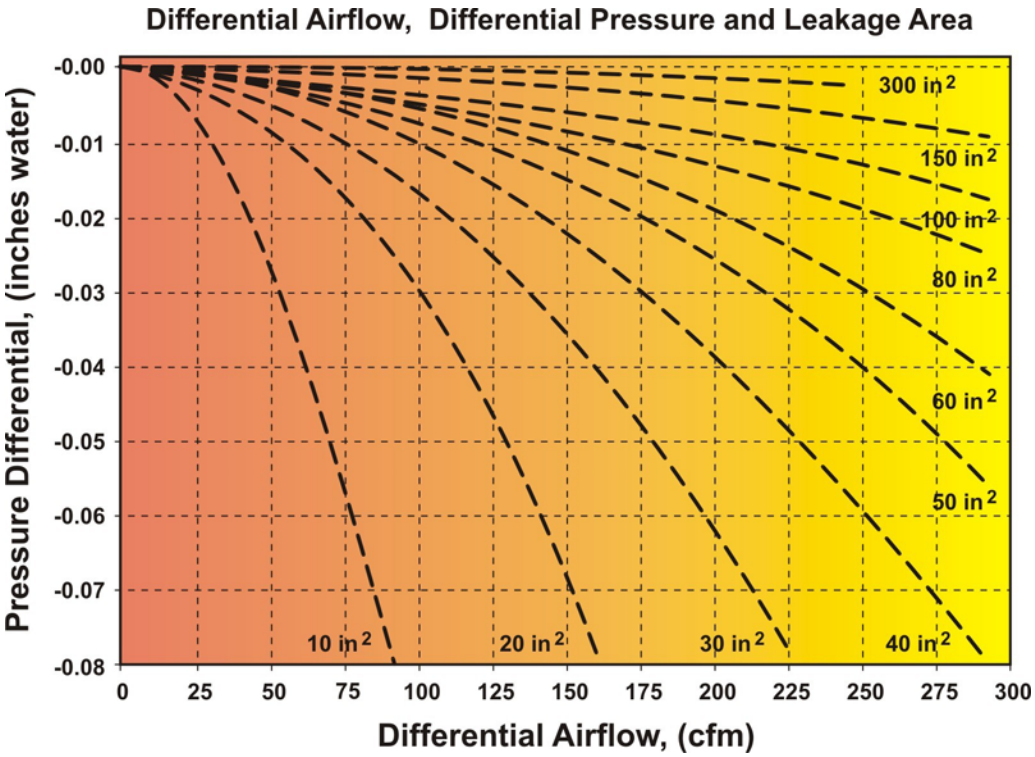

Figure 4. Empirical relationship between differential airflow, differential pressure, and leakage areas.

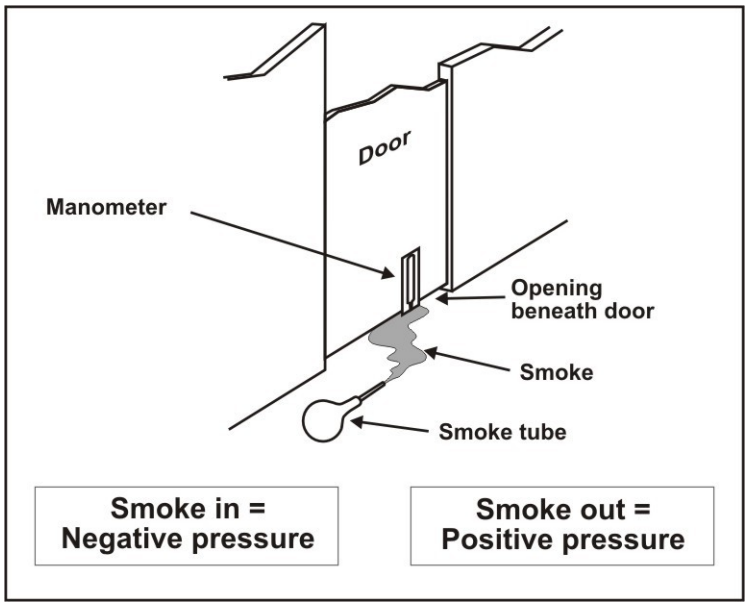

Figure 5. Smoke tube testing and manometer placement to determine the direction of airflow into and out of a room

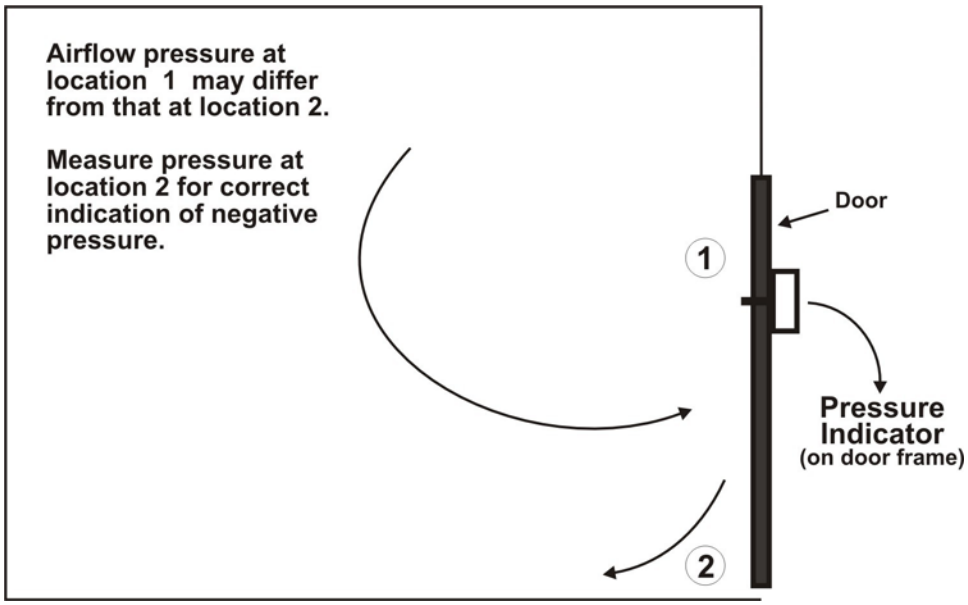

Figure 6. Cross-sectional view of a room showing the location of negative pressure measurement

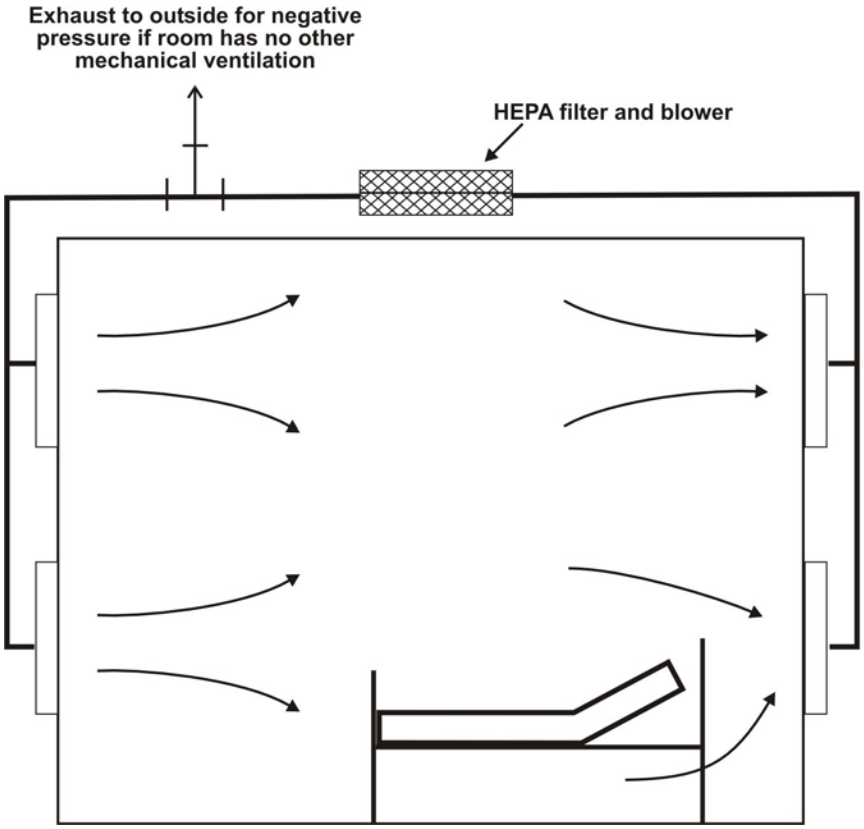

Figure 7. Fixed ducted room-air recirculation system using a HEPA filter inside an air duct

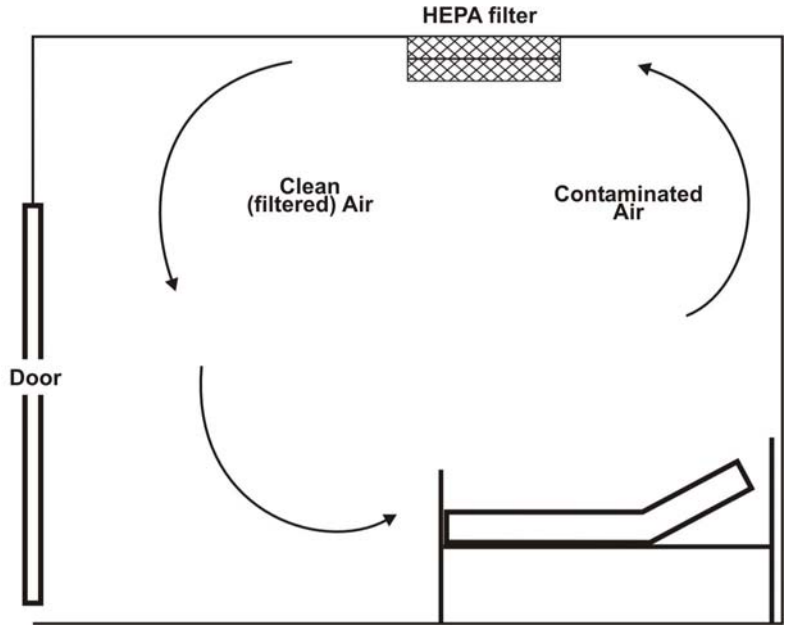

Figure 8. Fixed ceiling-mounted room-air recirculation system using a HEPA filter

Table 1. TB Risk Assessment Worksheet

This is a model worksheet and should be considered for use in performing TB risk assessments for health-care facilities and nontraditional facility-based settings. Facilities with more than one distinct type of setting will need to apply this table to each setting.

Incidence of TB cases in your community

What is the incidence of TB cases in your community (county or region served by the healthcare setting) and how does it compare to the state and national average? (Incidence is the number of TB disease cases in your community last year. A rate of TB cases per 100,000 persons should be obtained for comparison.)* This information may be obtained from the state or local health department.	Community rate_____ State rate _____ National rate _____ Facility rate _____ Department 1 rate _____ Department 2 rate _____ Department 3 rate _____
Does your health-care setting treat patients with suspected or confirmed TB disease? (Include both inpatient and outpatient services.)	Yes No
If yes, how many patients with suspected and confirmed TB disease are treated in your health-care setting in a year (inpatient and outpatient)? Check laboratory data, infection-control records, and databases containing discharge diagnoses.	Year No. patients Suspect Confirmed In past year _____ _____ Past 2 years _____ _____ Past 5 years _____ _____
If no, does your health-care setting have a plan for the triage of patients with suspected or confirmed TB disease?	Yes No
Currently, does your health-care setting have a cluster of persons with confirmed TB disease that may be due to ongoing transmission of *M. tuberculosis* within your setting? (Include both inpatient and outpatient services.)	Yes No

Risk classification

For inpatient settings	
How many inpatient beds are in your health-care setting?	
How many patients with TB disease are treated in the inpatient setting in a year? Review laboratory data, infection-control records, and databases containing discharge diagnoses.	In past year _____ Past 5 years _____
Depending on the number of beds and TB patients treated in a year, what is the risk classification for your health-care setting? (See Table 2 for frequency of TB screening.)	o Low risk o Medium risk o Potential ongoing transmission
For outpatient settings	
How many TB patients are seen at your health-care setting in a year? Review laboratory data, infection-control records, and databases containing discharge diagnoses.	In past year _____ Past 5 years _____
Is your health-care setting a TB clinic?	Yes / No
Is there a relatively high incidence of TB disease in the community that the health-care setting serves?	Yes / No
Is there evidence of person-to-person (e.g., patient-to-patient, patient-to-HCW, HCW-to-patient, or HCW-to-HCW) transmission in the health-care setting? Use information from case reports; determine if any recent TST conversions have occurred among HCWs (a TST conversion is a $\geq$10 mm increase in the size of the TST induration over a two-year period in an HCW with a documented negative two-step TST baseline TST result, or in a person who is not a HCW with a negative TST result within two years). See Supplement 3 for QFT use.	Yes / No
Is there evidence of ongoing or unresolved health-care–associated transmission in the health-care setting (based on case reports)?	Yes / No

Is there a high incidence of immunocompromised patients or HCWs in the health-care setting?	Yes / No
Have patients with drug-resistant TB disease been encountered in your health-care setting within the last 5 years?	Yes / No Year _____
When was the first time a risk classification was done for your health-care setting?	_____
Considering the items above, would your health-care setting need a higher risk classification?	Yes / No
Depending on the number of TB patients seen on an outpatient or nontraditional setting basis in a year, what is the risk classification for your health-care setting? (See Table 2, Risk classifications for health-care settings and recommended frequency of screening for *M. tuberculosis* infection among HCWs.)	o Low risk o Medium risk o Potential ongoing transmission

Screening of HCWs for M. tuberculosis infection

Does the health-care setting have a TB screening program for HCWs?	Yes / No
If yes, which HCWs are included in the TB screening program? (Check all that apply.) o Physicians o Mid-level practitioners (nurse practitioners, physician's assistants) o Nurses o Administrators o Laboratory workers o Respiratory therapists o Physical therapists o Contract staff o Construction or renovation workers o Service workers	o Janitorial staff o Maintenance or engineering staff o Transportation staff o Dietary staff o Receptionists o Trainees and students o Volunteers o Others_____
Is baseline skin testing performed with two-step TST for HCWs?	Yes / No
Is baseline testing performed with QFT for HCWs?	Yes / No
Does the setting have a serial TB screening program for HCWs to test for *M. tuberculosis* infection?	Yes / No
How frequently are eligible HCWs tested for *M. tuberculosis* infection?	
Are the *M. tuberculosis* infection test records maintained for HCWs?	Yes / No
Where are the *M. tuberculosis* infection test records for HCWs maintained?	
Who maintains the *M. tuberculosis* infection test records for HCWs?	
If the setting has a serial TB screening program for HCWs to test for *M. tuberculosis* infection, what is the conversion rate for the past year?†	
List the *M. tuberculosis* infection test conversion rate for the past five years.	2 years ago _____ 3 years ago _____ 4 years ago _____ 5 years ago _____
Has the *M. tuberculosis* infection test conversion rate been increasing or decreasing, or has it remained the same over the past five years?	Increasing _____ Decreasing _____ No change _____
Do any areas of the health-care setting or any group of HCWs (e.g., lab workers, emergency department staff, waiting rooms, clinics, respiratory therapists, HCWs who attend bronchoscopies) have an *M. tuberculosis* infection test	Yes / No If yes, list _____ _____ _____

conversion rate that exceeds the healthcare setting's annual average?	
For HCWs who have positive TB test results and who leave employment at the health setting, are efforts made to communicate test results and recommend follow-up of LTBI treatment with the local health department or their primary physician (consistent with state and federal regulations)?	Yes / No Not applicable

TB infection-control program

Is there a written TB infection-control plan?	Yes / No
Who is responsible for the infection control program?	_____
When was the TB infection-control plan first written?	
When was the TB infection-control plan last reviewed or updated?	
Does the written infection-control plan need to be updated based on timing of last update (i.e., >1 year, changing TB epidemiology of the community or setting, the occurrence of a TB outbreak, change in state or local TB policy, or other factors related to a change in risk for transmission of *M. tuberculosis*)?	Yes / No
Is there an infection-control committee (or another committee with infection control responsibilities) for the health-care setting?	Yes / No
If yes, which groups are represented on the infection-control committee? (Check all that apply.) o Physicians o Nurses o Epidemiologists o Engineers o Pharmacists	o Laboratory personnel o Health and safety staff o Administrator o Risk assessment o Quality control o Others (specify)
If no, what committee is responsible for infection control in the setting?	

Implementation of TB infection-control plan (based on review by Infection Control Committee)

Is there a designated person responsible for implementation of an infection-control plan in your health-care setting? If yes, name? _____	Yes / No
Based on a review of the medical records, what is the average number of days from • Presentation of patient until collection of specimen _____ • Specimen collection to receipt by laboratory _____ • Receipt by laboratory until smear results are provided to health-care provider _____ • Initiation of standard anti-tuberculosis therapy _____ • Receipt by laboratory until culture results are provided to health-care provider _____ • Receipt by laboratory until drug-susceptibility results are provided to health-care provider _____ • Receipt of drug-susceptibility results until adjustment of anti-tuberculosis treatment, if indicated _____ • Admission of patient until placement in AII _____ • Suspicion of TB disease to initiation of AII _____	
Through what means (e.g., review of TST conversion rates, patient medical records, time analysis) are lapses in infection control recognized?	
What mechanisms are in place to correct lapses in infection control?	
Based on measurement in routine quality control (QC) exercises, is the infection-control plan being properly implemented?	Yes / No
Is ongoing training and education about TB infection-control practices provided for HCWs?	Yes / No

Laboratory processing of TB-related specimens, tests, and results (based on laboratory review)

Which of the following tests are either conducted in-house at your health-care setting's laboratory or sent out to a reference laboratory?	In-house	Sent out
a) AFB smears		
b) Culture using liquid media (e.g., Bactec, MB-BacT)		
c) Culture using solid media		
d) Drug-susceptibility testing		
e) Nucleic acid testing		

What is the usual transport time for specimens to reach the laboratory for the following tests?

a) AFB smears _____
b) Culture using liquid media (e.g., Bactec, MB-BacT) _____
c) Culture using solid media _____
d) Drug-susceptibility testing _____
e) Other (specify) _____
f) Nucleic acid testing

Does the laboratory at your health-care setting or the reference laboratory used by your health-care setting report AFB smear results for all patients within 24 hours of receipt of specimen? What is the procedure for weekends?	Yes / No _____ _____

Environmental controls

Which environmental controls are in place in your health-care setting? Check all that apply:

o Local exhaust ventilation (enclosing devices, exterior devices)
o General ventilation (e.g., single-pass system, recirculation system.)
o Air-cleaning methods such as high-efficiency particulate air (HEPA) filtration, ultraviolet germicidal irradiation (UVGI)
o AII rooms

What are the design and actual air exchange rates (air changes per hour) for various rooms

Room	Design	Actual
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Which of the following local exhaust ventilation devices are used in your health-care setting? Check all that apply:

o Exterior devices or
Enclosing devices such as
o Laboratory hoods
o Booths for sputum induction
o Tents or hoods for enclosing or placing a patient in AII

What general ventilation systems are used in your health-care setting?

o Single-pass system o Variable air volume (VAV)
o Recirculation system o Constant air volume (CAV)
o Other_____

What air-cleaning methods are used in your health-care setting?

HEPA filtration
o Fixed room-air recirculation systems
o Portable room-air recirculation systems
UVGI

o Duct irradiation o Upper-air irradiation o Portable room-air cleaners	
How many AII rooms are in the health-care setting?	
What ventilation methods are used for AII rooms? Check all that apply. o Single-pass heating, ventilating, and air conditioning (HVAC) o Recirculating HVAC systems o Fixed room recirculating units o HEPA filtration o UVGI o Other	
Does your health-care setting employ, have access to, or collaborate with an environmental engineer (e.g., Professional Engineer) or other professional with appropriate expertise (e.g., Certified Industrial Hygienist) for consultation on design specifications, installation, maintenance, and evaluation of environmental controls?	Yes / No
Are environmental controls regularly checked and maintained with results recorded in maintenance logs?	Yes / No
Are AII rooms checked daily for negative pressure when in use?	Yes / No
Is the directional airflow in AII rooms checked daily when in use with smoke tubes or visual checks?	Yes / No
Are these results readily available?	Yes / No
What procedures are in place if the AII room pressure is not negative?	_____
Do AII rooms meet the recommended pressure differential of 0.01 inch water column negative to surrounding structures?	Yes / No

Respiratory protection program

Is there a written respiratory protection program?	Yes / No
Which HCWs are included in the respiratory protection program? Check all that apply. o Physicians o Mid-level practitioners (NP, PA) o Nurses o Administrators o Laboratory personnel o Contract staff o Construction or renovation staff o Service personnel	o Janitorial staff o Maintenance or engineering staff o Transportation staff o Dietary staff o Students o Others (specify)_____ _____ _____ _____ _____ _____ _____ _____ _____
What types of respirators are used in this setting for all HCWs working with TB patients (include manufacturer, model, and specific application such as ABC model 1234 for bronchoscopy; DEF model N95)? _____ _____ _____	
Is there annual respiratory protection training for HCWs performed by a trained fit tester?	Yes / No

Is there initial fit testing for HCWs? If yes, when and how frequently is it conducted Is there periodic fit testing for HCWs? If yes, when and how frequently is it conducted	Yes / No _____ Yes / No
What method of fit testing is used? Describe:_____ _____	
Is qualitative fit testing used?	Yes / No
Is quantitative fit testing used?	Yes / No

Reassessment of TB risk

How frequently is the TB risk assessment conducted or updated in the health-care setting?	
When was the last TB risk assessment conducted?	
What problems were identified at the last TB risk assessment? A. _____ _____ B. _____ _____ C. _____ _____ D. _____ _____ E. _____ _____ F. _____ _____	
What actions were taken to control the problems identified at the last TB risk assessment? A. _____ _____ B. _____ _____ C. _____ _____ D. _____ _____ E. _____ _____ F. _____ _____	
Did the risk classification need to be revised as a result of the last TB risk assessment?	Yes / No

***** If the population served by the health-care facility is not representative of the community in which the facility is located, an alternate comparison population may be appropriate.

† TST conversion rate is calculated by dividing the number of conversions among HCWs by the number of HCWs who were tested (and therefore who have been have TST negative baseline and follow up results for administrative purposes) during a certain time period. See Supplement 3 for QFT use in calculations of conversion.

Table 2. Risk classifications for health-care settings and recommended frequency of screening for *M. tuberculosis* infection among HCWs[*]

Setting Type	Risk Classification[†]		
	Low risk	***Medium risk***	***Potential ongoing transmission***[§]
Inpatient <200 Beds	• <3 TB patients/year	• ≥3 TB patients/year	• Evidence of ongoing *M. tuberculosis* transmission, regardless of setting
Inpatient ≥200 beds	• <6 TB patients/year	• ≥6 patients/year	
Outpatient settings and Nontraditional facility-based settings	• <3 TB patients/year	• ≥3 TB patients/year	
TB treatment facilities	Settings where • Persons who will be treated have been demonstrated to have LTBI and not TB disease • No cough-inducing or aerosol-generating procedures are performed, *and* • A system is in place to promptly detect and triage persons who have signs or symptoms of TB disease to a setting where persons with TB disease are treated	• Settings where persons with TB disease are encountered • Settings that do not otherwise meet the criteria for *low risk*	
Laboratories	• Laboratories where clinical specimens that might contain *M. tuberculosis* are not manipulated	• Laboratories where clinical specimens that might contain *M. tuberculosis* are manipulated	
Recommendations for Screening Frequency			
Baseline two-step TST [¶]	Yes, for all HCWs upon hire	Yes, for all HCWs upon hire	Yes, for all HCWs upon hire
TST for HCWs upon unprotected exposure to *M. tuberculosis*	Perform a contact investigation, i.e., administer one TST as soon as possible at the time of exposure, and if the TST result is negative, place another TST 8–10 weeks after the end of exposure to *M. tuberculosis*[**]		
Serial TST screening of HCWs	No [††,§§]	Every 12 months[††]	As needed in the investigation of potential ongoing transmission [§,¶¶]

[*] The term "HCWs" refers to all paid and unpaid persons working in health-care settings who have the potential for exposure to *M. tuberculosis* through air space shared with persons with infectious TB disease.

[†] Settings that serve communities with a relatively high incidence of TB disease or that treat high-risk populations such as those with HIV infection or other immunocompromising conditions, or that treat patients with drug-resistant TB disease may need to be classified as medium risk even if they meet the low risk criteria.

[§] A classification of potential ongoing transmission should be applied to a specific group of HCWs or to an area of the health-care setting in which evidence of ongoing transmission is apparent, if such a group or area can be identified. Otherwise, a classification of potential ongoing transmission should be applied to the entire setting. The classification of potential ongoing transmission should be used as a temporary classification only. It warrants immediate investigation, and corrective steps; after it has been determined that ongoing transmission has ceased, the setting should be reclassified as medium-risk. It is recommended to maintain the classification of medium risk for at least one year.

[¶] All HCWs should have baseline two-step TST results at each new healthcare setting, even if the setting is determined to be low-risk. In some settings, there may be a choice not to perform baseline TB screening or serial TB screening for HCWs who will never be in contact with, or have shared air space with patients who have TB disease (e.g., telephone operators who work in a separate building from patients), or who will never be in contact with clinical specimens that may contain *M. tuberculosis*. Establishment of a reliable baseline result can be beneficial if subsequent screening is needed after an unexpected exposure to *M. tuberculosis*. See Supplement 3 for QFT use in screening.

[**] Procedures for contact investigations should not be confused with the two-step TST, which is used for newly hired HCWs. In contact investigations, contacts receive one TST as soon as possible after the exposure, and if the TST result is negative, another TST should be placed 8–10 weeks after the end of exposure.

[††] HCWs whose duties do not include contact with patients or TB specimens do not need to be included in the serial TB screening program.

[§§] Because the positive predictive value of TST (Supplement 2, Section A.4) is low where prevalence of LTBI is low, serial TST screening of HCWs in these settings might yield high rates of false-positive results.

[¶¶] The frequency of testing for infection with *M. tuberculosis* will be determined by the risk assessment for the setting. During an investigation of potential ongoing transmission of *M. tuberculosis*, testing for *M. tuberculosis* infection may need to be performed every 8–10 weeks until lapses in infection controls have been corrected and no further evidence of ongoing transmission is apparent.

Table 3. Risk Classification Examples

The following hypothetical situations illustrate the way in which assessment data are used to assign a risk classification. The risk classifications are for settings where patients with suspected or confirmed infectious TB disease are expected to be encountered.

Example A. A 150-bed hospital is located in a small city. During the preceding year, the hospital admitted two patients with a diagnosis of TB disease. One was admitted directly to airborne infection isolation (AII) and one stayed on a medical ward for two days before being placed in an AII room. A contact investigation of exposed HCWs by hospital infection-control personnel in consultation with the state or local health department did not identify any health-care–associated transmission. *Risk classification: Low risk.*

Example B. The setting is an ambulatory-care site in which a TB clinic is held two days per week. In the preceding year, care was delivered to six patients with TB disease and approximately 50 persons with LTBI. No instances of transmission of *M. tuberculosis* were noted. *Risk classification: Medium risk* (because it is a TB clinic).

Example C. The setting is a large publicly funded hospital in a major metropolitan area. The hospital admits an average of 150 patients with TB disease each year, comprising 35% of the city burden. The setting has a strong TB infection-control program (i.e., annually updates infection-control plan, fully implements infection-control plan, and the setting has enough AII rooms as described in Supplement 4), and an annual *M. tuberculosis* infection test conversion rate among HCWs of 0.5%. The *M. tuberculosis* infection test conversion rate is the percentage of HCWs who have converted their TST results within a specified time period. Conversion rates are calculated by dividing the number of *M. tuberculosis* infection test conversions among HCWs in the setting in a specified period of time (numerator) by the total number of HCWs who received tests in the setting over the same period of time (denominator) multiplied by 100. No evidence of health-care–associated transmission is apparent. The hospital has strong collaborative linkages with the state or local health department. *Risk classification: Medium risk,* with close ongoing surveillance for episodes of transmission from unrecognized cases of TB disease, *M. tuberculosis* infection test conversions in HCWs as a result of health-care–associated transmission, and specific groups or areas in which a higher risk for health-care–associated transmission exists.

Example D. The setting is an inpatient area of a correctional facility. A proportion of the inmates were born in countries where TB disease is endemic. Two cases of TB disease were diagnosed in inmates during the preceding year. *Risk classification: Medium risk.* Correctional facilities should be classified as at least *medium risk.*

Example E. A hospital located in a large city admits 35 patients with TB disease per year and has an overall HCW *M. tuberculosis* infection test conversion rate of 1.0%. However, on annual testing, three of the 20 respiratory therapists tested had *M. tuberculosis* infection test conversions, for a rate of 15%. All of the respiratory therapists who tested positive received medical evaluations, had TB disease excluded, were diagnosed with LTBI, and were offered and completed a course of treatment for LTBI. None of the respiratory therapists had known exposures to *M. tuberculosis* outside the hospital. The problem evaluation revealed that 1) the respiratory therapists who converted had spent part of their time in the pulmonary function laboratory where induced sputum specimens were collected, and 2) the ventilation in the laboratory was inadequate. *Risk classification: Potential ongoing transmission for the respiratory therapists* (due to evidence of health-care–associated transmission). The rest of the setting was classified as *medium risk*. To address the problem, booths were installed for sputum induction. No *M. tuberculosis* infection test conversions were noted at the repeat testing three months later, and the respiratory therapists were then reclassified back to *medium risk*.

Example F. The setting is an ambulatory-care center associated with a large health maintenance organization (HMO). The patient volume is high, and the HMO is located in the inner city where TB rates are the highest in the state. During the preceding year, one patient who was known to have TB disease presented to the center. The person was recognized as a TB patient on his first visit and was promptly triaged to an emergency department with AII capacity. While in the ambulatory-care center, the patient was held in an area separate from HCWs and other patients and instructed to wear a surgical or procedure mask. A contact investigation was conducted among exposed staff, and no *M. tuberculosis* infection test conversions were noted. *Risk classification: Low risk.*

Example G. The setting is a clinic for the care of persons infected with HIV. The clinic serves a large metropolitan area and a patient population of 2,000. The clinic has an AII room and a TB infection-control program. All patients are screened for TB disease upon enrollment, and anyone with respiratory complaints

is placed in AII while being evaluated. During the past year, seven patients who received care in the clinic were subsequently found to have TB disease. All patients were promptly isolated in an AII room and no contact investigations were performed. The local health department was promptly notified in all cases. Annual testing has shown an *M. tuberculosis* infection test conversion rate of 0.3%, which is relatively low compared to the rate seen in the hospital with which the clinic is associated. *Risk classification: Medium risk* (because persons infected with HIV may be encountered here).

Example H. A home health-care agency employs 125 workers, many of whom perform duties including nursing, physical therapy, and basic home care. The agency did not care for any patients with suspected or confirmed TB disease in the prior year. Approximately 30% of the agency's workers are foreign-born, many of whom have immigrated within the last five years. At baseline two-step testing, four had a positive initial TST result, and two had a positive second-step TST result. All except one of these workers was foreign-born. Upon further screening, none were found to have TB disease. The home health-care agency is based in a major metropolitan area and delivers care to a mostly poor, medically under-served community with TB case rates that are higher than the community as a whole. *Risk classification: Low risk*. Given that workers might be from populations at higher risk for LTBI and subsequent progression to TB disease due to foreign birth and recent immigration, or HIV-infected clients may be over-represented, *medium risk* could be considered.

Table 4. Environmental Controls Record and Evaluation[*]

Type of environmental control[†]	Number[§]	Location in the health-care setting[¶]	How often maintained[**]	How often evaluated	Last evaluation date	Next evaluation due

[*] Not all settings will be able to supply information for all parts of the table.
[†] For example, UVGI, airborne infection isolation (AII) room, HEPA filters, in each location in the health-care setting.
[§] Number of UVGI units, AII rooms, HEPA filters, in each location in the health-care setting.
[¶] For example, inpatient rooms, emergency departments, bronchoscopy suites, sputum induction rooms, outpatient areas, waiting areas.
[**] Daily, weekly, monthly, annually.

Table 5. Administrative, Environmental, and Respiratory Protection Controls for Selected Health-Care Settings

Settings Where Patients With Suspected or Confirmed Infectious Tuberculosis (TB) Disease Are Not Expected to Be Encountered			
Setting	**Administrative Controls[*]**	**Environmental Controls[†]**	**Respiratory Protection Controls[§]**
Triage only: Initial evaluation of patients who will transfer to another setting	• Implement a written infection-control plan in the setting for triage of patients with suspected or confirmed TB disease. Update annually. • Promptly recognize and transfer patients with suspected or confirmed TB disease to a facility that treats persons with TB disease. • Prior to transfer out of this setting, hold the patient in an area separate from health-care workers (HCWs) and other persons.	• Settings in which patients with suspected or confirmed TB disease are rarely seen and not treated do not need an airborne infection isolation (AII) room. • Place any patient with suspected or confirmed TB disease in an AII room if available, or in a separate room with the door closed, away from others and not in a waiting area. Air-cleaning technologies such as high-efficiency particulate air (HEPA) filtration and ultraviolet germicidal irradiation (UVGI) may be used to increase the number of equivalent air changes per hour (ACH) (Supplement 4, Section IV).	• Settings in which patients with suspected or confirmed TB disease are rarely seen and not treated do not need a respiratory protection program. • If the patient has signs or symptoms of infectious TB disease, consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.
Settings Where Patients With Suspected or Confirmed Infectious Tuberculosis (TB) Disease Are Expected to Be Encountered			
Inpatient settings			

	• Perform an annual risk assessment for the setting • Develop and implement a written infection control plan for the setting and evaluate and update annually • Provide TB training, education, and screening for HCWs as part of the infection control plan • Establish protocols for problem evaluation. • Collaborate with state or local health departments when appropriate. • When possible, postpone nonurgent procedures that may put HCWs at risk of possible exposure to *M. tuberculosis* until patients are determined to not have TB disease or are noninfectious.	• In settings with a high volume of patients with suspected or confirmed TB disease, at least one room should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as high-efficiency particulate air (HEPA) filtration and ultraviolet germicidal irradiation (UVGI) may be used to increase the number of equivalent air changes per hour (ACH) (Supplement 4, Section IV).	• For HCWs, visitors[¶] and others entering the AII room of a patient with suspected or confirmed infectious TB disease at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result) consider having the patient wear a surgical or procedure mask, if possible, (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.

Patient rooms	• Place patients with suspected or confirmed TB disease in an AII room.	• At least one inpatient room should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as high-efficiency particulate air (HEPA) filtration and ultraviolet germicidal irradiation (UVGI) may be used to increase the number of equivalent air changes per hour (ACH) (Supplement 4, Section IV).	• For HCWs and visitors[¶] entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • Persons infected with HIV or who have other immunocompromising conditions should especially avoid exposure to persons with TB disease. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result) consider having the patient wear a surgical or procedure mask, if possible, (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.
Emergency departments	• Implement a plan for triage of patients with suspected or confirmed TB disease. • Patients with signs or symptoms of infectious TB disease should be moved to an AII room as soon as possible.	• In settings classified as medium risk or potential ongoing transmission, at least one room should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4).	• For HCWs and visitors[¶] entering the AII room of a patient with suspected or confirmed TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result) consider having the patient wear a surgical or procedure mask, if possible, (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.

Intensive-care units (ICU)	• Place patients with suspected or confirmed infectious TB disease in an AII room, separate from HCWs and other patients, if possible.	• In settings with a high volume of patients with suspected or confirmed TB disease, at least one room should meet requirements for an AII room to be used for such patients (Supplement 4, Table 17). • Bacterial filters should be used routinely in breathing circuits of patients with suspected or confirmed TB disease and should filter particles 0.3 μm in size in unloaded and loaded situations with a filter efficiency of ≥95%. The filter should be in the expiratory (or venting) side of the respirator.	• For HCWs, visitors[¶] and others entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease and is suspected of being contagious (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.,

Surgical suites	• Schedule a patient with suspected or confirmed TB disease for surgery when a minimum number of HCWs and other patients are present, and as the last surgical case of the day to maximize the time available for removal of airborne contamination (Supplement 4, Table 16). For postoperative recovery, place patients in a room that meets requirements for an AII room.	• If a surgical suite has an operating room (OR) with an anteroom, that room should be used for TB cases. • If surgery is needed, use a room or suite of rooms that meet requirements for AII rooms (Supplement 4, Section IV). This may involve changing setting of the HVAC system. • If an AII or comparable room is not available for surgery or post-operative recovery, air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • If it has an anteroom. Reversible flow rooms (OR or isolation) are not recommended by AIA or ASHRAE. • Bacterial filters should be used routinely in breathing circuits of patients with suspected or confirmed TB disease and should filter particles 0.3 μm in size in an unloaded and loaded situation with a filter efficiency of ≥95%.	• For HCWs present during surgery of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators, unvalved, should be worn. • Standard surgical or procedure masks for HCWs may not have fitting or filtering capacity for adequate protection. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, before and after the procedure. • Valved or positive-pressure respirators should not be used, as they do not protect the sterile surgical field.

Laboratories**	• Conduct a laboratory-specific risk assessment. • In general, biosafety level (BSL)-2 practices, procedures, containment equipment, and facilities are required for nonaerosol-producing manipulations of clinical specimens. BSL-3 practices, procedures, and containment equipment may be necessary for certain aerosol-generating or aerosol-producing manipulations.	• Should meet requirements for clinical microbiology laboratories in accordance with guidelines by Biosafety in Microbiological and Biomedical Laboratories (BMBL) and the American Institute of Architects (AIA). • Perform all manipulation of clinical specimens that could result in aerosolization in a certified class I or II biosafety cabinet (BSC).	• For laboratory workers who manipulate clinical specimens (from patients with suspected or confirmed infectious TB disease) outside of a BSC, at least N95 disposable respirators should be worn.
Bronchoscopy suites††	• Use a dedicated room to perform bronchoscopy procedures. • If a patient with suspected or confirmed infectious TB disease must undergo bronchoscopy, schedule the procedure when a minimum number of HCWs and other patients are present and schedule the patient as the last of the day. • Do not allow another procedure to be performed in the bronchoscopy suite until sufficient time has elapsed for adequate removal of *M. tuberculosis*-contaminated air (Supplement 4, Table 16).	• Bronchoscopy suites should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • Closing ventilatory circuitry and minimizing opening of such circuitry of intubated and mechanically-ventilated patients may minimize exposure. • Keep patients with suspected or confirmed infectious TB disease in the bronchoscopy suite until coughing subsides.	• For HCWs present during bronchoscopic procedures of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. Protection greater than an N95 such as a full-facepiece elastomeric respirator or a powered air-purifying respirator (PAPR) should be considered. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, before and after the procedure.

Sputum induction and inhalation therapy rooms	• Implement a written infection-control plan in the setting. Update annually. • Use a dedicated room to perform sputum induction and inhalation therapy. • Schedule sputum induction and inhalation therapy when a minimum number of HCWs and other patients are present, and schedule the patient as the last of the day. • Do not perform another procedure in a booth or room where sputum induction or inhalation therapy on a patient with suspected or confirmed infectious TB disease was performed until sufficient time has elapsed for adequate removal of *M. tuberculosis*-contaminated air (Supplement 4, Table 16).	• Perform sputum induction and inhalation therapy in booths with special ventilation, if possible. If booths are not available, sputum induction or inhalation therapy rooms should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • Keep patients with suspected or confirmed infectious TB disease in the sputum induction or inhalation therapy room after sputum collection or inhalation therapy until coughing subsides.	• For HCWs present during sputum induction and inhalation therapy of a patient with suspected or confirmed infectious TB disease, a respirator with a level of protection of at least N95 disposable respirators should be worn. Protection greater than an N95 such as a full-facepiece elastomeric respirator or PAPR should be considered (Supplement 5). • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, before and after the procedure.

Autopsy suites	• Ensure proper coordination between attending physician(s) and pathologist(s) for proper infection control and specimen collection during autopsies performed on bodies with suspected or confirmed infectious TB disease. • Allow sufficient time to elapse for adequate removal of *M. tuberculosis*-contaminated air (Supplement 4, Table 16) before performing another procedure.	• Autopsy suites should meet ACH requirements for an AII room to be used for bodies with suspected or confirmed TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • Consider using local exhaust ventilation to reduce exposures to infectious aerosols and vapors from embalming fluids.	• For HCWs present during autopsy on bodies with suspected or confirmed infectious TB disease, a respirator with a level of protection of at least an N95 disposable respirator should be worn. Protection greater than an N95 such as a full-facepiece elastomeric respirator or PAPR should be considered (Supplement 5) especially if aerosol generation is likely. • If another procedure cannot be delayed until sufficient time has elapsed for adequate removal of *M. tuberculosis*-contaminated air, staff should continue wearing respiratory protection while in the room (Supplement 4, Table 16).
Embalming rooms	• Implement a written infection-control plan in the setting. Update annually.	• Embalming rooms should meet ACH requirements for an AII room to be used for bodies with suspected or confirmed TB disease (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV).	• For staff present during embalming procedures on bodies with suspected or confirmed infectious TB disease, a respirator with a level of protection of at least N95 disposable respirators should be worn. Protection greater than an N95 such as a full-facepiece elastomeric respirator or PAPR should be considered (Supplement 5) especially if aerosol generation is likely. • If another procedure cannot be delayed until sufficient time has elapsed for adequate removal of *M. tuberculosis*-contaminated air, staff should continue wearing respiratory protection while in the room.

Outpatient settings[§§]	Administrative Controls[*]	Environmental Controls[†]	Respiratory Protection[§]
	• Perform an annual risk assessment for the setting • Develop and implement a written infection control plan for the setting and evaluate and update annually • Provide TB training, education, and screening for HCWs as part of the infection control plan • Establish protocols for problem evaluation • Collaborate with state or local health departments when appropriate	Environmental controls should be implemented based on the types of activities that are performed. Patients with suspected or confirmed infectious TB disease requiring transport should be transported as discussed below under Emergency Medical Services.	• For HCWs, visitors[¶] and others entering an AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present. • If risk assessment indicates the need for respiratory protection, drivers or HCWs who are transporting patients with suspected or confirmed infectious TB disease in an enclosed vehicle should wear at least an N95 disposable respirator. The risk assessment should consider the potential for shared air. • A surgical or procedure mask should be placed on patients with signs or symptoms of infectious TB disease, if possible (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.

TB treatment facilities[¶¶]	• Physically separate immunosuppressed patients from those with suspected or confirmed infectious TB. • Schedule appointments to avoid exposing HIV-infected or other severely immunocompromised persons to *M. tuberculosis*.	• If patients with TB disease are treated in the clinic, at least one room should meet requirements for an AII room (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • Perform all cough-inducing or aerosol-generating procedures using environmental controls (e.g., booth) or in an AII room. • Keep patients in the booth or AII room until coughing subsides. • Do not allow another patient to enter the booth or AII room until sufficient time has elapsed for adequate removal of *M. tuberculosis*-contaminated air (Supplement 4, Table 16).	• For HCWs, visitors[¶] and others entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.

Dental-care settings	• If possible, postpone dental procedures of patients with suspected or confirmed infectious TB disease until the patient is determined not to have TB disease or to be noninfectious.	• Treat patients with suspected or confirmed infectious TB disease in a room that meets requirements for an AII room (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV).	• For dental staff performing procedures on a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn.
Medical offices and ambulatory-care settings	• Implement a written infection-control plan in the setting. Update annually.	• In medical offices or ambulatory care settings where patients with TB disease are treated, at least one room should meet requirements for an AII room to be used for patients with suspected or confirmed infectious TB disease (Supplement 4, Table 17).	• For HCWs in medical offices or ambulatory care settings with patients with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.

Dialysis units	• Schedule dialysis for patients with TB disease when a minimum number of HCWs and other patients are present and at the end of the day to maximize the time available for removal of airborne contamination (Supplement 4, Table 16).	• Perform dialysis for patients with suspected or confirmed infectious TB disease in a room that meets requirements for an AII room (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV).	• For HCWs or visitors¶ entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present. • If risk assessment indicates the need for respiratory protection, drivers or HCWs who are transporting patients with suspected or confirmed infectious TB disease in an enclosed vehicle should wear at least an N95 disposable respirator. The risk assessment should consider the potential for shared air.
Nontraditional facility-based settings			

	• Perform an annual risk assessment for the setting • Develop and implement a written infection control plan for the setting and evaluate and update annually • Provide TB training, education, and screening for HCWs as part of the infection control plan • Establish protocols for problem evaluation • Collaborate with state or local health departments when appropriate	C C	Environmental controls should be implemented based on the types of activities that are performed, as discussed above. Patients with suspected or confirmed infectious TB disease requiring transport should be transported as discussed below under Emergency Medical Services.	• For HCWs or visitors entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible (e.g., if patient is not using a breathing circuit), during transport, in waiting areas, or when others are present.

Emergency medical services (EMS)	• Include exposed emergency medical HCWs in the contact investigation of patients with TB disease if administrative, environmental, and respiratory protection controls for TB infection control were not followed.	• Patients with suspected or confirmed infectious TB disease requiring transport should be transported in an ambulance whenever possible. The ambulance ventilation system should be operated in the non-recirculating mode and the maximum amount of outdoor air should be provided to facilitate dilution. If the vehicle has a rear exhaust fan, use this fan during transport. Airflow should be from the cab (front of vehicle) over the patient and out the rear exhaust fan. • If an ambulance is not used, the ventilation system for the vehicle should bring in as much outdoor air as possible, and the system should be set to non-recirculating. If possible, physically isolate the cab from the rest of the vehicle and place the patient in the rear seat wearing a surgical mask.	• If risk assessment indicates the need for respiratory protection, drivers or HCWs who are transporting patients with suspected or confirmed infectious TB disease in an enclosed vehicle should wear at least an N95 disposable respirator. The risk assessment should consider the potential for shared air. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.

Medical settings in correctional facilities	• Follow recommendations for inpatient and outpatient settings as appropriate. • In waiting rooms or areas, follow recommendations for TB treatment facilities. • If possible, postpone transporting patients with suspected or confirmed infectious TB disease until they are determined not to have TB disease or to be noninfectious.	• At least one room should meet requirements for an AII room (Supplement 4, Table 17). • Air-cleaning technologies such as HEPA filtration and UVGI may be used to increase the number of equivalent ACH (Supplement 4, Section IV). • When transporting patients with suspected or confirmed infectious TB disease in a vehicle (ideally an ambulance), if possible, physically isolate the cab (the front seat) from rest of the vehicle, have the patient sit in the back seat, and open the windows.	• For HCWs or others entering the AII room of a patient with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.

Home-based health-care and outreach settings	• Patients and household members should be educated regarding the importance of taking medications, respiratory hygiene and cough etiquette procedures, and proper medical evaluation. • If possible, postpone transporting patients with suspected or confirmed infectious TB disease until they are determined not to have TB disease or to be noninfectious. • Some patients may be instructed to remain at home until they are determined not to have TB disease or to be noninfectious.	• Do not perform cough-inducing or aerosol-generating procedures unless appropriate environmental controls are in place (Supplement 4), or perform those procedures outside, if possible.	• For HCWs entering the homes of patients with suspected or confirmed infectious TB disease, at least N95 disposable respirators should be worn. • For HCWs transporting patients with suspected or confirmed infectious TB disease in a vehicle, at least N95 disposable respirators should be worn. • If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.
Long-term care settings (e.g., hospices, skilled nursing facilities)	• Patients with suspected or confirmed infectious TB disease should not be treated in a long-term care setting unless proper administrative and environmental controls and a respiratory protection program are in place.	• Do not perform cough-inducing or aerosol-generating procedures unless appropriate infection controls are in place (Supplement 4), or perform those procedures outside , if possible.	• If the patient has signs or symptoms of infectious TB disease (positive AFB sputum smear result), consider having the patient wear a surgical or procedure mask, if possible, during transport, in waiting areas, or when others are present.

[*] Administrative controls must be implemented to ensure the effectiveness of environmental controls and respiratory protection programs, and should be in place for all settings where patients with suspected or confirmed TB disease will be encountered. Administrative controls include a written TB infection-control plan (which should be reassessed at least annually), assignment of responsibility for the plan, setting risk assessment, HCW risk classification, HCW training and education, and a TB screening program to test HCWs for infection with *M. tuberculosis*.

[†] Environmental controls include local exhaust and general ventilation (i.e., achieving negative pressure), utilizing airborne infection isolation [AII] rooms) and air-cleaning methods (i.e., HEPA filtration, UVGI).

[§] All settings where patients with suspected or confirmed TB disease will be encountered need to have a respiratory protection program. A respiratory protection program may not be necessary for settings where patients with TB disease are not encountered or where a procedure exists for the prompt transfer of patients with suspected or confirmed TB disease to a setting where they can be evaluated.

[¶] Visitors with suspected or confirmed TB disease should not have contact with patients (including contact with those who have suspected or confirmed TB disease).

[**] Laboratories that are not based in inpatient settings should observe the same TB infection-control measures as laboratories in inpatient settings.

[††] Some bronchoscopy suites are built for positive pressure.

[§§] Though most of these settings are routinely considered "outpatient," they may be part of inpatient services in certain settings. If so, follow the recommendations for inpatient settings for patient rooms.

[¶¶] TB treatment facilities may include TB clinics, infectious disease clinics, or pulmonary clinics.

Table 6. Suggested components of an initial TB training and education program for health-care workers (HCWs)

Clinical information

- Basic concepts of *M. tuberculosis* transmission, pathogenesis, and diagnosis, including the difference between LTBI and TB disease and the possibility of reinfection after previous infection with *M. tuberculosis* or TB disease
- Signs and symptoms of TB disease and the importance of a high index of suspicion for patients or HCWs with these symptoms
- Indications for initiation of airborne infection isolation (AII) of inpatients with suspected or confirmed TB disease
- Policies and indications for discontinuing AII precautions
- Principles of treatment for LTBI and for TB disease (indications, use, effectiveness, potential adverse effects)

Epidemiology of TB

- Epidemiology of TB in the local community, in the United States, and worldwide
- Risk factors for TB disease

Infection-control practices to prevent and detect *M. tuberculosis* transmission in health-care settings

- Overview of the TB infection-control program
- Potential for occupational exposure to infectious TB disease in health-care settings
- Principles and practices of infection control to reduce the risk for transmission of *M. tuberculosis*, including the hierarchy of TB infection-control measures, written policies and procedures, monitoring, and control measures for HCWs at increased risk for exposure to *M. tuberculosis*
- Rationale for infection-control measures and documentation evaluating the effect of these measures in reducing occupational TB risk exposure and *M. tuberculosis* transmission
- Reasons for testing for *M. tuberculosis* infection, significance of a positive test for *M. tuberculosis* infection, importance of participation in a TB screening program, and importance of retaining documentation of previous test for *M. tuberculosis* infection, chest radiograph results and treatment for LTBI and TB disease
- Efficacy and safety of BCG vaccination and principles of screening for *M. tuberculosis* infection and interpretation in BCG recipients
- Procedures for investigating a *M. tuberculosis* infection test conversion or TB disease occurring in the workplace
- Joint responsibility of HCWs and employers to ensure prompt medical evaluation after *M. tuberculosis* test conversion or development of signs or symptoms of TB disease in HCWs
- Role of HCW in preventing transmission of *M. tuberculosis*
- Responsibility of HCWs to promptly report a diagnosis of TB disease to the setting's administration and infection-control program
- Responsibility of clinicians and the infection-control program to report to the state or local health department a suspected case of TB disease in a patient (including autopsy findings) or HCW
- Responsibilities and policies of the setting, the local health department, and the state health department to ensure confidentiality for HCWs with TB disease or LTBI
- Responsibility of the setting to inform EMS staff who transported a patient with suspected or confirmed TB disease
- Responsibilities and policies of the setting to ensure that an HCW with TB disease is noninfectious before returning to duty
- Importance of completing therapy for LTBI or TB disease to protect the HCW's health and to reduce the risk to others
- Proper implementation and monitoring of environmental controls (Supplement 4)
- Training for safe collection, management, and disposal of clinical specimens
- OSHA required record-keeping on HCW *M. tuberculosis* infection test conversions
- Record-keeping and surveillance of TB cases among patients in the setting
- Proper use of respiratory protection (Supplement 5) and the need to inform the infection-control program of factors that might affect the efficacy of respiratory protection as required by OSHA

- Success of adherence to infection-control practices in decreasing the risk for transmission of *M. tuberculosis* in health-care settings

TB and immunocompromising conditions

- Relationship between infection with *M. tuberculosis* and medical conditions and treatments that can lead to impaired immunity
- Available tests and counseling and referrals for persons with HIV infection, diabetes, and other immunocompromising conditions associated with an increased risk for progression to TB disease
- Procedures for informing employee health or infection-control personnel of medical conditions associated with immunosuppression
- Policies on voluntary work reassignment options for immunocompromised HCWs
- Applicable confidentiality safeguards of the health-care setting, locality, and state

TB and public health

- Role of the state and local health department's TB control program in screening for LTBI and TB disease, providing treatment, conducting contact investigations and outbreak investigations, and providing education, counseling, and responses to public inquiries
- Roles of CDC, including the National Institute for Occupational Safety and Health (NIOSH) and of OSHA
- Availability of information, advice, and counseling from community sources, including universities, local experts, and hotlines
- Responsibility of the setting's clinicians and infection-control program to promptly report a case of suspected TB disease or a cluster of TST conversions to the state or local health department
- Responsibility of the setting's clinicians and infection-control program to promptly report to the state or local health department a person with suspected or confirmed TB disease who leaves the setting against medical advice

Table 7. Criteria for obtaining medical and diagnostic evaluation for HCWs

Purpose of testing	TST results
1. Baseline	1. ≥10 mm is positive (either first- or second-step)
2. Serial testing (without known exposure)	2. Increase of ≥10 mm is positive
3. Known exposure (close contact) Increase of >10 mm is positive in those with baseline or prior serial TST result of <10 mm.	3a. ≥5 mm is positive in persons who have a baseline TST result of 0 mm 3b. Increase of ≥10 mm is positive in those with a negative baseline TST result or prior serial screening TST result ≥0 mm.

Table 8. Factors affecting treatment decisions during the medical and diagnostic evaluation, by TST result

TST result ≥5 mm is positive in	**TST result ≥10 mm** is positive in	**TST result ≥15 mm** is positive in*
• Persons infected with HIV • Recent contacts of a person with TB disease • Persons with fibrotic changes on chest radiograph consistent with prior TB disease • Organ transplant recipients and other immunosuppressed persons (e.g., persons receiving ≥15 mg/day of prednisone for ≥1month)§ • TB suspects¶	• Recent immigrants (i.e., within the last five years) from countries with a high incidence of TB disease • Persons who inject illicit drugs • Residents and employees (including HCWs)† of the following high-risk congregate settings - hospitals and other health-care facilities - long-term care facilities (e.g., hospices, skilled nursing facilities) - residential facilities for patients with AIDS or other immunocompromising conditions - correctional facilities - homeless shelters • Mycobacteriology laboratory personnel • Persons with any of the following clinical conditions or immunocompromising conditions that place them at high risk for TB disease - silicosis - diabetes mellitus - chronic renal failure - some hematologic disorders (e.g., leukemias and lymphomas) - other specific malignancies (e.g., carcinoma of the head, neck, or lung) - unexplained weight loss of ≥10% of ideal body weight - gastrectomy - jejunoileal bypass • Persons living in areas with high incidence of TB disease • Children <4 years of age • Infants, children, and adolescents exposed to adults at high risk for developing TB disease • Locally identified high-risk groups	• Persons with no known risk factors for TB disease • HCWs who are otherwise at low-risk for TB disease and who received baseline testing at the start of employment as part of a TB screening program†

* TST results ≥15 mm is positive in anyone. These persons should receive a symptom screen and do not need be tested again. They should be evaluated for TB disease, and if disease is excluded, they should be offered treatment for LTBI if they have no contraindication to treatment.

† For HCWs who are otherwise at low risk for LTBI and progression to TB disease if infected, and who received baseline testing at the start of employment as part of a TB infection control screening program, a TST result of ≥15 mm (instead of 10 mm) can be considered to be positive. Although a result of ≥10 mm on baseline or follow-up testing is considered a positive result for HCWs for the purposes of referral for medical and diagnostic evaluation, if the TST result is 10–14 mm (on baseline or follow-up testing), the referring clinician may not recommend treatment of LTBI (*324*).

§ The risk for TB disease in persons treated with corticosteroids increases with higher dose and longer duration of corticosteroid use.

¶ Persons considered to be TB suspects may be treated on the basis of the medical and diagnostic evaluation, regardless of the TST results.

Table 9. Recommended quality control (QC) procedural observation checklist for placing tuberculin skin tests (TSTs), Mantoux method

Date_____
Trainer (QC by)_____ Trainee (TST placed by)_____
Scoring: √ or Y = yes; X or N = no; NA = not applicable

I. **Preliminary**
____ Utilizes appropriate hand hygiene methods before starting
____ Screens patient for contraindications (severe adverse reactions to prior TST)[1]
____ Uses well-lit area

II. **Syringe filled with exactly 0.1 ml of 5 tuberculin units (TU) PPD antigen**
____ Removes antigen vial from refrigeration and confirms that it is 5 TU PPD antigen
____ Checks label and expiration date on vial
____ Marks opening date on multidose vial
____ Fills immediately after vial removed from refrigeration
____ Cleans vial stopper with antiseptic swab
____ Twists needle onto syringe to ensure tight fit
____ Removes needle guard
____ Inserts needle into the vial
_____ Draws slightly over 0.1 ml of 5 TU PPD into syringe
____ Removes excess volume or air bubbles to exactly 0.1 ml of 5 TU PPD while needle remains in vial to avoid wastage of antigen
____ Removes needle from vial
____ Returns antigen vial to the refrigerator immediately after filling[2]

III. **TST administration site selected and cleaned**
____ Selects upper third of forearm with palm up[3]
____ Selects site ≥2 inches from elbow, wrist, or other injection site
____ Selects site free from veins, lesions, heavy hair, bruises, scars, muscle ridge
____ Cleans arm site with antiseptic swab using circular motion from center to outside
____ Allows site to dry thoroughly before administering antigen

IV. **Needle inserted properly to administer antigen**
____ Rests arm on firm, well-lit surface
____ Stretches skin slightly[4]
____ Holds needle bevel-up and tip at 5 ! 15 degree angle to skin
____ Inserts needle in first layer of skin with tip visible beneath skin
____ Advances needle until entire bevel is under the first layer of skin
____ Releases stretched skin
____ Injects entire dose slowly
____ Forms wheal, as liquid is injected
____ Removes needle without pressing area
____ Activates safety feature of device per manufacturer's recommendations, if applicable
____ Places used needle and syringe immediately in puncture-resistant container without recapping needle
____ Immediately measures wheal to ensure 6–10 mm in diameter
Actual wheal measurement _____mm
_____ If blood or fluid present, blots site lightly with gauze or cotton ball
____ Discards used gauze or cotton ball according to local standard precautions
____ If the TST is administered incorrectly (too deeply or too shallow) and the wheal is inadequate (< 6 mm), a new TST should be placed immediately. It is preferable to apply the second TST on the other arm or in a different area of the same arm (at least two inches from the first site) so that the TST result will be easier to read.
____ Utilizes appropriate hand hygiene methods after placing TST

V. **Explanation to the client regarding care instructions for the injection site**

____ The wheal (bump) is normal and will remain about ten minutes
____ Do not touch wheal; avoid scratching
____ Avoid pressure or bandage on injection site
____ Rare local discomfort and irritation does not require treatment
____ May wash with soap and water (without pressure) after one hour
____ No lotions or liquids on site, except for light washing, as above
____ Keep appointment for reading!

[*] Severe adverse reactions to the TST are very rare, but include ulceration, necrosis, vesiculation, or bullae at the test site, or anaphylactic shock, and are the only contraindications to having a TST administered.

[†] Prefilling of syringes is not recommended. Skin tests should be given as soon after the syringe has been filled as possible (*28*).

[§] If neither arm is available or acceptable for testing, the back of the shoulder is a good alternate TST administration site (*326*).

[¶] Stretch skin by placing non-dominant hand of HCW on subject's forearm below the needle insertion point and then applying traction in the opposite direction of the needle insertion. Be careful not to place the nondominant hand of the HCW opposite the administration needle if the patient is likely to move during the procedure; this may cause an accidental needle-stick injury. In children and others who are likely to move during the procedure, some trainers prefer stretching the skin in the opposite direction of the needle insertion by placing the nondominant hand of HCW under the subject's forearm. This method should not be used for persons with poor skin turgor.

Table 10. Recommended quality control (QC) procedural observation checklist for reading tuberculin skin test (TST) results, palpation method

Date_____
Trainer (QC by)_____ Trainee (TST result read by)_____
Scoring: √ or Y = yes; X or N = no; NA = not applicable

I. **Preliminary**
____ Utilizes appropriate hand hygiene methods before starting
____ Keeps fingernails shorter than fingertips to avoid misreading TST result
____ Keeps TST reading materials at hand (eyeliner pencil or ballpoint pen*, ruler)
____ Uses well-lit area

II. **Inspect for site**
____ Inspects for the site of the injection

III. **Palpate - finding margin ridges (if any)**
____ Palpates with arm bent at elbow 90 degree angle
____ Lightly sweeps two inches diameter from injection site in four directions
____ Uses zigzag feather-like touch
____ Repeats palpation with arm bent at elbow at a 45 degree angle to determine presence or absence of induration.

If induration is present, continue with these steps.[†]

IV. **Mark - placing marks**
____ Holds palm over injection site
____ Moves finger pad toward injection site
____ Drops fingernail on skin at indurated margin before marking with marker
____ Places single dot with marker on skin at fingernail, left
____ Places single dot with marker on skin at fingernail, right
____ Inspects dots, repeats finger movements towards indurated margin, adjusts dots if needed
____ Dots are transverse (perpendicular) to long axis of forearm

V. **Measure - placing and reading ruler**
____ Places zero ruler line inside left dot edge
____ Reads ruler line inside right dot edge
____ Reads lower mark when between scale divisions
____ Utilizes appropriate hand hygiene methods after reading TST

VI. **Documenting results**
____ Correctly records results in mm; only a single measured induration in mm should be recorded
Trainee's measurement _____mm
Trainer's ("gold standard") measurement _____mm
Trainee's result within 2 mm of gold standard reading?[§] _____ (yes / no)

* A fine-tipped eyeliner pencil or ballpoint pen may be used as a marker. An eyeliner pencil is useful for TST training and for blinded independent duplicate readings (BIDRs) because marks are easily removed. Alternative TST result reading methods have been described (*314-316,321*).
[†] If induration is not present, record the TST result as 0 mm and go to the end of this form (VI).
[§] For example, if the TST trainer reads the TST result as 11 mm (the "gold standard" reading), the trainee's TST reading should be between 9 –13 mm to be considered correct. Only a single measured induration in mm should be recorded.

Table 11. Indications for two-step TSTs

Situation	Recommended testing
No previous TST result	Two-step baseline TSTs
Previous negative TST result (documented or not) >12 months prior to new employment	Two-step baseline TSTs
Previous documented negative TST result ≤12 months prior to new employment	Single TST needed for baseline testing (this will be the second-step)
Two or more previous documented negative TSTs, but most recent TST >12 months prior to new employment	Single TST; two-step testing is not necessary
Previous documented positive TST result	No TST
Previous undocumented positive TST result*	Two-step baseline TST(s)
Previous BCG vaccination	Two-step baseline TST(s)
Programs that use serial QFT	See Supplement 3

* For newly hired HCWs and other persons who will be tested on a routine basis (such as residents of long-term care facilities), a previous positive TST is not a contraindication to a subsequent TST unless the test was associated with severe ulceration or anaphylactic shock, which are very rare adverse events (*227*,*228*,*342*). If the previous positive TST result is not documented, administer two-step TSTs.

Table 12. Common drug regimens for treatment of LTBI

Drugs	Months of Duration	Interval	Minimum Doses
Isoniazid (INH)	9* (preferred)	Daily	270
		Twice weekly	76
INH	6	Daily	180
		Twice weekly	52
Rifampin	4	Daily	120
Rifampin/Pyrazinamide (RZ)	Generally should not be offered for treatment of LTBI		

* Nine months of INH is preferred, but six months of INH or four months of rifampin are acceptable alternatives.

Table 13. Interpretation of QFT-G results

QFT Result	Interpretation
Positive (ESAT-6 and/or CFP-10 responsiveness detected)	*M. tuberculosis* infection likely
Negative (No ESAT-6 or CFP-10 responsiveness detected)	*M. tuberculosis* infection unlikely, but cannot be excluded especially when 1. any illness is consistent with tuberculosis disease, 2. likelihood of progression to disease (e.g., because of immunosuppression) is increased
Indeterminate	Test not interpretable

Table 14. Conditions requiring caution in interpreting negative QFT results

- Human immunodeficiency virus (HIV) infection or acquired immunodeficiency syndrome (AIDS)
- Immunosuppressive drugs including those used for managing organ transplantation and TNF-α antagonists
- Diabetes
- Silicosis
- Chronic renal failure
- Hematological disorders (e.g., myeloproliferative disorders, leukemias and lymphomas)
- Specific malignancies (e.g., carcinoma of the head, neck, or lung).

Table 15. Interpretations of TST and QFT results according to the purpose of the test for *M. tuberculosis* infection in a health-care associated setting

Purpose of testing	TST	QFT
1. Baseline	1. ≥10 mm is positive (either first- or second-step)	1. Positive (only one-step)
2. Serial testing (without known exposure)	2. Increase of ≥10 mm is positive	2. Change from negative to positive
3. Known exposure (close contact)	3a. ≥5 mm is positive in persons who have a baseline TST result of 0 mm 3b. Increase of ≥10 mm is positive in those with a negative baseline TST result or previous follow-up screening TST result ≥0 mm	3. Change to positive

Table 16. Air changes per hour (ACH) and time required for removal efficiencies of 99% and 99.9% of airborne contaminants*

ACH	Minutes required for removal efficiency of † 99%	99.9%
2	138	207
4	69	104
6	46	69
12	23	35
15	18	28
20	7	14
50	3	6
400	<1	1

Table 17. Ventilation recommendations for selected areas in new or renovated health-care settings

Area	Minimum mechanical ACH	Minimum outdoor ACH*	Air movement relative to adjacent areas	All air exhausted directly outdoors†
Microbiology laboratory	6	—	In	Yes
Anteroom to airborne infection isolation (AII) room	10	—	In / out	Yes
AII room §,¶	12	2	In	Yes
Autopsy suite	12	—	In	Yes
Bronchoscopy room	12	2	In	Yes
Emergency department and radiology waiting rooms	12	2	In	Yes
Operating room or surgical room	15** 15†† 25††	3** 15†† 5††	Out	—

Adapted from (*1*,*118*).

* ANSI / ASHRAE Standard 62.1-2004, *Ventilation for Acceptable Indoor Air Quality*, should be consulted for outside air recommendations in areas that are not specified here (*378*,*382*).

† If it is not possible to exhaust all the air to the outdoors in existing or renovated facilities, the air may be recirculated after passing through HEPA filtration. In AII rooms, such recirculation is acceptable only if the air is recirculated back to the same room and not to other areas of the setting.

§ AII rooms in *existing* settings should have an airflow of ≥6 mechanical ACH; air-cleaning devices may be used to increase the equivalent ACH.

¶ Patients requiring a protective environment (PE) room (e.g., severely immunocompromised patients) who also have TB disease require protection from common airborne infectious microorganisms.

** Recommendation of AIA (*118*).

†† Recommendation of ASHRAE (*382*).

Table 18. Nonpowered air-purifying respirator filter classes certified under 42 CFR 84

Resistance to Filter Efficiency Degradation	Filter Efficiencies		
	95 (95%)*	**99** (99%)*	**100** (99.97%)*
N (**N**ot resistant to Oil)	N95	N99	N100
R (**R**esistant to oil)	R95	R99	R100
P (Oil **P**roof)	P95	P99	P100

*The number in parenthesis is the minimum allowable laboratory filter efficiency value

Table 19. Model Framework for Medical Evaluation Questionnaire for N95 Disposable Respirator Users – Section 1

1. Today's date: _____
2. Your name: _____
3. Your age (to nearest year): _____
4. Sex (circle one): Male ./ Female
5. Your height: _____ft. _____in.
6. Your weight: _____lbs.
7. Your job title _____
8. A phone number where you can be reached by the healthcare professional who reviews this questionnaire (include area code): _____
9. The best time to phone you at this number: _____
10. Has your employer told you how to contact the healthcare professional who will review this questionnaire (circle one): Yes / No
11. Check the type of respirator you will use (you can check more than one category):
    a. ___ N-, R-, or P- disposable respirator (filter-mask, non-cartridge type only).
    b. ___ Half-facepiece type
    c. ___ Full-facepiece type
    d. ___ Powered air-purifying respirator (PAPR) – tight-fitting
    e. ___ Powered air-purifying respirator (PAPR) – loose-fitting
    f. ___ Other type (supplied-air or self-contained breathing apparatus)
12. Have you worn a respirator (circle one): Yes / No
    If "yes," what types: _____
    _____

Table 20. Model Framework for Medical Evaluation Questionnaire for N95 Disposable Respirator Users – Section 2

1. Do you currently smoke tobacco, or have you smoked tobacco in the last month: Yes / No
2. Have you ever had any of the following conditions?
   a. Seizures (fits): Yes / No
   b. Diabetes (sugar disease): Yes / No
   c. Allergic reactions that interfere with your breathing: Yes / No
   d. Claustrophobia (fear of closed-in places): Yes / No
   e. Trouble smelling odors: Yes / No
3. Have you ever had any of the following pulmonary or lung problems?
   a. Asbestosis: Yes / No
   b. Asthma: Yes / No
   c. Chronic bronchitis: Yes / No
   d. Emphysema: Yes / No
   e. Pneumonia: Yes / No
   f. Tuberculosis: Yes / No
   g. Silicosis: Yes / No
   h. Pneumothorax (collapsed lung): Yes / No
   i. Lung cancer: Yes / No
   j. Broken ribs: Yes / No
   k. Any chest injuries or surgeries: Yes / No
   l. Any other lung problem that you've been told about: Yes / No
4. Do you currently have any of the following symptoms of pulmonary or lung illness?
   a. Shortness of breath: Yes / No
   b. Shortness of breath when walking fast on level ground or walking up a slight hill or incline: Yes / No
   c. Shortness of breath when walking with other people at an ordinary pace on level ground: Yes / No
   d. Have to stop for breath when walking at your own pace on level ground: Yes / No
   e. Shortness of breath when washing or dressing yourself: Yes / No
   f. Shortness of breath that interferes with your job: Yes / No
   g. Coughing that produces phlegm (thick sputum): Yes / No
   h. Coughing that wakes you early in the morning: Yes / No
   i. Coughing that occurs mostly when you are lying down: Yes / No
   j. Coughing up blood in the last month: Yes / No
   k. Wheezing: Yes / No
   l. Wheezing that interferes with your job: Yes / No
   m. Chest pain when you breathe deeply: Yes / No
   n. Any other symptoms that you think may be related to lung problems: Yes / No
5. Have you ever had any of the following problems?
   Heart attack: Yes / No
   Stroke: Yes / No
   Angina: Yes / No
   Heart failure: Yes / No
   Swelling in your legs or feet (not caused by walking): Yes / No
   Heart arrhythmia (heart beating irregularly): Yes / No
   High blood pressure: Yes / No
   Any other heart problem that you've been told about: Yes / No
6. Have you ever had any of the following symptoms?
   Frequent pain or tightness in your chest: Yes / No
   Pain or tightness in your chest during physical activity: Yes / No
   Pain or tightness in your chest that interferes with your job: Yes / No
   In the past two years, have you noticed your heart skipping or missing a beat: Yes / No
   Heartburn or indigestion that is not related to eating: Yes / No
   Any other symptoms that you think may be related to heart or circulation problems: Yes / No
7. Do you currently take medication for any of the following problems?
   Breathing or lung problems: Yes / No

Heart trouble: Yes / No
Blood pressure: Yes / No
Seizures (fits): Yes / No

8. If you've used a respirator, have you ever had any of the following problems?
   (If you've never used a respirator, check the following space and go to question 9) _____
   Eye irritation: Yes / No
   Skin allergies or rashes: Yes / No
   Anxiety: Yes / No
   General weakness or fatigue: Yes / No
   Any other problem that interferes with your use of a respirator: Yes / No
9. Would you like to talk to the health care professional who will review this questionnaire about your answers to this questionnaire? Yes / No
   Please explain Yes answers (use back of form if necessary)_____
   _____

Are you currently taking any medications? Yes / No
If yes, please list _____
_____

Do you now or have you ever smoked? Yes / No
At what age did you start smoking?_____
How long ago did you quit smoking?_____
How many packs per day did or do you smoke? _____